MISTAKES AND PROBLEMS IN GAS SAMPLING AND CONDITIONING

Irrespective of the current political statements and changes in the US the world understands that a reduction of emissions is essential in order to limit the climate change within an acceptable level. The first step to achieve this target is an acceptance and approval of (continuous) emission monitoring systems. Continuous Emission Monitoring Systems (CEMS), from the operators' point of view, is often a very unloved topic: As the measurements are solely made to comply with legal requirements and local laws it is seen as a cost intensive investment with no direct returns on investment. This differentiates CEM Systems from Process Analytical Technology (PAT) which is business case driven and allows the operators to improve the outcome of the process. Some of the operators might use the abbreviation CEM for "cry every morning", to sum up the challenges these kind of systems face.

In order to improve the acceptance of CEM systems two major challenges have to be achieved:

1. Low Total Cost of Ownership which includes the initial investment as well as the operating costs
2. Accuracy and long-term stability

The surprising fact is that the sampling and conditioning system is the key component which defines success or failure in accomplishing this target, rather than the analyser itself. Tendencies to measure the gas directly in the process via (often optical) insitu technologies are more and more declining in favour of the traditional extractive measurement. The reason for this trend is on one hand the limitation that most insitu analysers only allow operators to measure one component whilst, on the other hand, they do not offer the flexibility of an extractive system: In cases where additional components or lower measurement ranges and limits have to be monitored, the simple change or addition of the analyser component is able to solve the issue.

Nevertheless, sampling and conditioning components in extractive monitoring can even cause problems or falsification of the sample itself. This article is about the identification of potential weak points for the different sampling and conditioning components.

Gas Sampling

When taking a gas sample from a process or stack it is necessary to remove dust and other particles at the same time to ensure a sample temperature above the water vapour resp. acid dew point. If not, condensation will occur, the filter will be blocked and water soluble measuring gas components like SO_2, NO_2, HCL, H_2S or NH_3 will be washed out uncontrollably. Two major areas of the gas sampling probe are extremely crucial: the probe and the probe housing itself as well as the connection from the probe to the heated sample line. As probes are often installed at the stack and often at a very high and windy position, the ambient temperatures can be lower than the ambient temperature at the ground. The heating element as well as effective insulation of the probe body are important in order to keep the temperature level above the condensation point. The accurate homogeneous probe temperature is essential as is the connection to the secondary sampling system, which represents another crucial point: the interface to the heated sample line. If the junction from the probe to the sample line has no additional insulation, cold spots can occur and cause condensational problems such as blocking lines and loss of water soluble gas components. Blocked lines cause a breakdown of the measurement and are very difficult to identify and rectify. Loss of gas components will falsify the measurement result. In addition, when trasporting the sample gas to the analyser house it is very important to prevent condensation with every millimeter. Therefore the heating cable, within the heated sample line, has to be positioned up to the very end of the line. Heat capacity and insulation also need to be calculated sufficiently according to the possible minimum ambient temperatures.

These described factors represent the need for a seamless connection of the Gas Sampling Probe and the heated sample line. AGT-PSG is the only company which manufactures all components from one source: With the biggest filter surface in the PSG Basic and PSG Plus Probes and the widest range of heated sample lines, the German supplier offers package solution which integrate seamlessly.

Gas Conditioning

When sample gas has passed through the heated probe and line – the most crucial process step follows: sample gas drying by cooler. The reason for this step is to protect the analyser against condensate and minimisation of water vapour affecting performance. Condensate will damage the sensitive and expensive analyser and water vapour cross sensitivities create inaccurate

readings. Therefore sample gas is cooled down to a stable dew point of e.g. 3°C, water vapour condenses and will be removed continuously. The transition from hot gas phase to cold gas phase, from a technical point of view, is the most demanding step because soluble measuring components like SO_2, NO_2, HCL, H_2S or NH3 will dissolute more or less in water resp. condensate depending on the heat exchanger design of the cooler. The duration of contact and the surface of sample gas and water droplets will especially have a major influence. The longer the retention time and the larger the water surface - the higher the wash out ratio of soluble gas components. In contrast, a sufficient retention time is important for transmitting the cooling energy and therefore stabilising the outlet dew point and thus guaranteeing a reliable and stable measurement value. The challenge is to find the perfect retention time for the specific heat exchanger design.

The New MAK 10-Twister has the Lowest Wash-out Rate

The new MAK10-Twister compressor cooler offers exactly this advantage. The cooler has negligible dissolution rates (≤1%) for e.g. SO_2 at 65°C inlet dew point and 100 to 300Nl/hr.

Currently the problem of wash out effects can be minimised by calibration via a wet cooler or with a humid test gas. But this procedure is just a compromise because in case of changing process conditions resp. changing water vapour dew point the quantity of condensate in the cooler is changing and therefore also the wash out ratio. This leads to inaccurate readings, especially at low measuring ranges, and that is exactly where we need to improve.

Reliability and reproducibility of measuring results is an inescapable requirement for the world-wide acceptance of emitting industries and therefore AGT-PSG consider it their job to enable trustworthy emission measurements by delivering Perfect Sample Gas.

The 2 companies AGT and PSG, whose products have been known and established for more than 40 years as a guarantee for reliability and longevity, merged as AGT-PSG in 2016. This combined more than 90 years of experience in the field of gas sampling and gas conditioning in one company

AGT-PSG is the only company worldwide to manufacture the entire range of products for continuous extractive gas analysis in-house. This allows the customer to purchase gas sampling probes, heated sample lines, sample gas coolers, as well as sample gas conditioning systems from a single source, directly from the manufacturer.

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